IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

RETROFIT OF AN ELECTROMECHANICAL RELAY WITH A DIGITAL RELAY: A REVIEW

[1]Srimayi Y, [2]Sarathkumar S

[1] Technical Support Engineer, [2] Senior Testing Engineer

L S Electricals, Hyderabad, India

sri.mayi99@gmail.com, sanjay.sarath1993@gmail.com

Abstract: "Prevention is better than cure". As like protecting our equipment from faults is the main thing that needs to be concentrated on. In this context, protective relays play a major role in sensing the faults and helps in isolating our equipment from it. As per the new trends, our relays are to be retrofitted with the latest technology that is prevailing in the market. That is the phase from an electro-mechanical relay to a digital relay. This paper deals with the draw backs of EM relays and how to overcome these problems with digital relays. It will be discussed with a case study. The work involved in the retrofit is done without disturbing existing wiring will be discussed.

Keywords: Protective Relay, Electro-Mechanical Relay, Digital Relay, Retrofit

I. INTRODUCTION

Protection relays play a vital role in the electrical system. In other words, we can say that it is HEART of the electrical system. As they are the ones which sense the abnormalities like voltage, current, frequency etc. in the system and give a command to the circuit breakers to trip so that we can isolate the faulty system from the healthy ones. They play a vital role in protecting the electrical system from various faults. Hence we will discuss the advantages digital relays have when compared to electro mechanical relays and will also discuss what procedure is involved in retrofitting a digital relay in place of electromechanical relay.

Like involvement of generations like industrial revolution, mobile phones etc., various generations exists for protective relays. Fig. 1 shows the image of an electromechanical relays which belongs to First generation [1]. These have served the electrical power systems over decades as faithful servants.

Fig. 1 Electromechanical Relay

Fig. 2 shows the image of a Solid state relay [2] which belongs to the second generation. These have served the electrical power systems for few years, later on which were dominated by digital relays.

Fig. 2 Solid state relay

Fig. 3 shows the image of a Digital relay [3] or Numerical which belongs to the present third generation. These are serving the industry for the last few years.

Fig. 3 Digital Relay

I. TIMELINE OF RELAYING

The traditional electromechanical to middle aged solid state relaying changed to digital relaying due to invention of microprocessors and microcontrollers. The timeline of the protective relays w.r.t to their evolution is shown in table I.

TABLE 1
TIMELINE OF RELAYING

Year	1900 to 1963	1963 to 1972	1972 to 1980	1980 onwards
Relay technology	Electromechanical Relay.	Static Relay	Digital Relay	Numerical Relay

Around 1980s the digital relay entered the market. Later with the advent of Digital signal processing, the new era of Numerical relay is started in 1990. Even though both are same, The distinction between digital and numerical relay rests on points of fine technical detail, and is rarely found in areas other than Protection. They can be viewed as natural developments of digital relays as a result of advances in technology.

II. NEED FOR RETROFITTING A RELAY

There are many a reasons why a relay is required to be retrofitted. One of the main reasons is that the spares of the electromechanical relay are becoming obsolete and there are many more advantages in the digital relays when compared to electromechanical relay.

a) Compact Size: Electromechanical relays have majority of mechanical parts in it which makes it bulky in size. But numerical relays will be compact as they have microprocessor in them.

b) Reliability: As the numerical relay consists of less or fewer components it results in less interconnections and reduced component failure.

c) Multifunction Capability: Electromechanical relays offer single function and single characteristics. Range of operation of electromechanical relay is narrow when compared to numerical relay. This is essentially required in latest smart technologies like microgrids [4].

d) Relay Characteristics: Curves like Normal Inverse, Very Inverse, Extremely Inverse and definite time [5] are present in a single Numerical relay. As these characteristics are stored in the memory of the microprocessor. Fig. 4 and 5 shows the Time Current Characteristics (TCC) of electromechanical and numerical relays respectively [6].

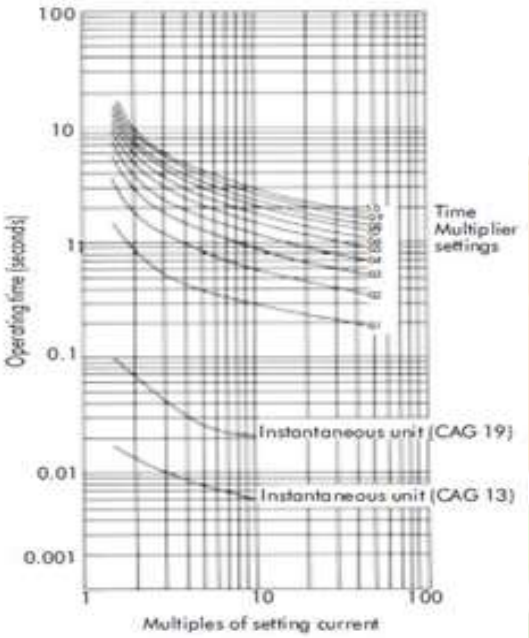

Fig. 4 TCC of Electromechanical relay

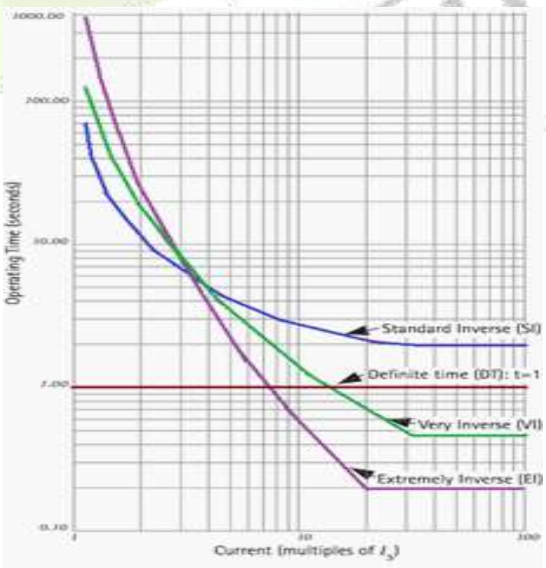

Fig. 5 TCC of Digital relay

e) Communication: A numerical relay can be communicated either with a data cable or through IP address in a computer/laptop.
f) Burden: The numerical relays have a very less burden when compared to electromechanical relay. For instance CDG11 relay- 3 VA & MICOMP111 relay- < 0.3 VA.
g) Data Storage: As a numerical relay has storage in it, all the live data, fault records, disturbance records can be stored which will be helpful in analyzing the system as and when required.
h) Sensitivity: Numerical relays are more sensible when compared to electromechanical relays as they can sense the minimum abnormalities present in the system.
i) Speed: With digital relays tripping action can be achieved much faster when compared electromechanical relays. This is essentially required in the present smart era to face the challenges efficiently [7].

V. PROCEDURE THAT INVOLVES IN RETROFITTING AN ELECTRO-MECHANICAL RELAY WITH A DIGITAL RELAY

Retrofitting word itself refers to the addition of latest technology to the older systems. We are here discussing on the various steps that are involved in retrofitting a digital relay in place of an electromechanical relay. First and foremost as per our application numerical relay must be opted i.e. whether it is protecting a feeder or Transformer or Generator or Transmission Line or Bus bar etc. After the selection of the relay, the steps that are included are discussed below.

A. INSTALLATION OF THE RELAY

i. Initially the main and control supply of the relay must be switched off.
ii. Ensure that the relay is completely de-energized.
iii. The wiring that is connected to the relay must be removed so that we can draw out the relay completely from the panel.
iv. There is a need to check the dimensions of the old relay and the new relay which is to be installed.
v. If the dimensions of both the relays match, then we can install the relay in the panel with the existing wiring available in the panel.
vi. If there is any difference in the dimensions of the relays i.e. if the digital relay has higher dimensions when compared to electromechanical relay then we should cut the panel accordingly or if our relay is smaller then we can use adapter plate to fix the relay in the panel.

B. WIRING OF THE RELAY

i. Ensure that the relay is properly fixed in the panel.
ii. One can use the existing wiring that is present in the panel to wire the new relay which was installed in the place of electromechanical relay [8].
ii. Connection diagrams of electromechanical relay and numerical relay are provided in the fig. 6 and 7 respectively, for instance.

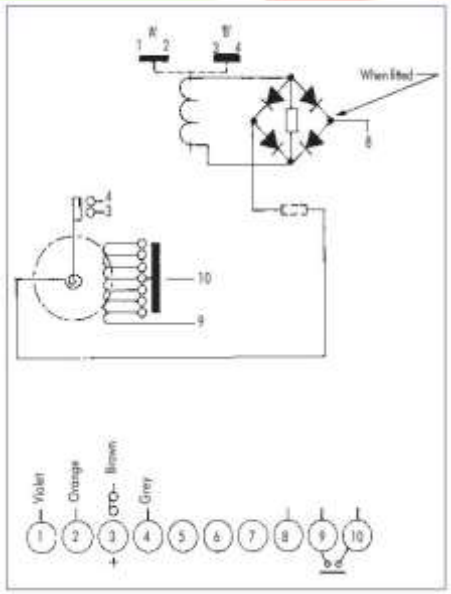

Fig. 6 Connection diagram of electromechanical relay

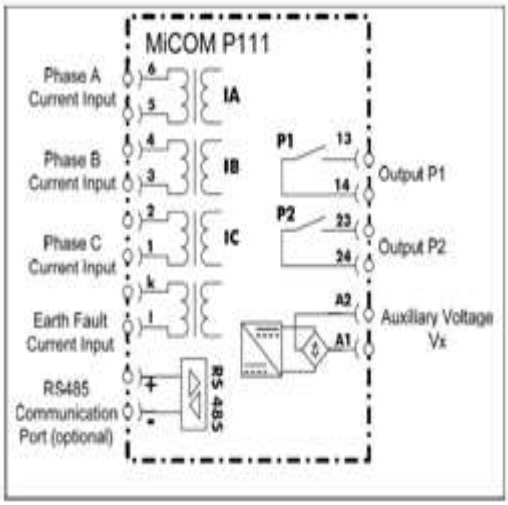

Fig. 7 Connection diagram of Digital Relay

iv. It should checked whether all the connections like CT/PT wiring, Over current, Earth fault protections, Alarm circuit wiring, Trip Circuit wiring , Main and control supply wiring etc to the relay are given or not.

C. PROGRAMMING OR COMISSIONING

A proper check must be done whether all the connections of the relay are properly connected or not.
After the inspection, the settings are to be taken from the history records and are to be programmed accordingly using the Human Machine Interface (HMI) present in the front side of the relay.
First step is to enter the present date and time in the relay.
It should also assign the required fault records as per the provision present in the relay which we have selected.
Then program the relay with the existing settings provided by the EIC.
Also can do different programmable logics in the relay as per our plant requirement.

D. TESTING OF THE RELAY

Ensure that the relay is properly installed, wired and programmed with available settings.
Relay must be tested [9-10] with the existing settings using a suitable relay test kit like MEGGER etc.
Ensure that the tested values should be within the prescribed range as per the relevant standards [11].
Before the completion of work, one should also analyze the settings which are provided and need to give any recommendations if required [12].
As a final check, one should check the tripping action of the Breaker that is assigned under a fault.

V. CONCLUSIONS

In this work, the importance of protective relays is discussed in brief. The taxonomy of relay generations also discussed. The demerits of electro mechanical relay and the merits and digital relay are highlighted. The need for retrofit and the work to be done are discussed in detail and can be used as a tool for work.

REFERENCES

[1] Alstom make CDG11 Relay Manual.
[2] Alstom make CTMM Relay Manual.
[3] Schneider Electric make Numerical Over Current and Earth Fault Relay Manual Model: MICOMP111.
[4] B. Koti Reddy, "Micro grid Protection Issues – A Case Study", *International Journal of Advanced Research Trends in Engineering and Technology (IJARTET,)*, vol. 7,iIssue 3,March 2020, pp -4.
[5] Schneider Electric make Numerical Over Current and Earth Fault Relay Manual Model: MICOMP111.
[6] B. Ramakoti, S. Hari Prasad Babu, K. Aravinda Swamy, K. Ramakrishna, B. Koti Reddy "Study of Fault Currents and Relay Coordination of a Chemical Industry After Integrating with PV Generation and Simulation with a Software", *International Journal of Engineering Trends and Technology (IJETT*), V42(5), 208-212 December 2016. ISSN:2231-5381. Www.ijettjournal.org. published by seventh sense research group.
[7] B. K. Reddy, and B. SreeBindu,"Recent Challenges in Electrical Engineering and the Solution with IT", *International Journal of Recent Technology and Engineering (IJRTE)*, vol. 8, issue. 2S11, September 2019, pp. 2412-2418.
[8] Srimayi Y. "Review on Field Testing of Protective Relays", *International Journal of Advanced Research Trends in Engineering and Technology (IJARTET*, vol. 7, issue 5, May 2020, pp 14-17.
[9] IS 9124-1979 (R2013), "Guide for maintenance and field testing of electrical relays", by Bureau of Indian Standards.
[10] FIST 3-8, "Operation, Maintenance, and Field Test Procedures for protective Relays and Associated Circuits", by U.S. Department of the Interior Bureau of Reclamation, May 2011.
[11] IEEE Std C37.233-2009, "IEEE Guide for Power System Protection Testing".
[12] Montignies, Patrick, Jover, Bernard,(2008) "Electromagnetic compatibility of digital protective relays installed in medium voltage switchgear" Petroleum and Chemical Industry Conference Europe – Electrical and Instrumentation Applications, PCIC Europe, pp 1-11.
[13] Sandeep S. R. et al. " Study and Analysis of Modern Numerical Relay Compared to Electromechanical Relay for Transmission of Power", *International Journal of Engineering Trends and Technology (IJETT) – vol. 4, issue 9, May 2017,* pp pp. 509 - 505.

.